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(72) Inventor DANIEL FRANK CUDZIK

(54) EASY-OPEN CONTAINER WALL

(71) We, REYNOLDS METALS COMPANY, a Corporation organised and existing under the laws of the State of Delaware, United States of America, of 6601 W. Broad Street, Henrico County, Richmond, Virginia 23261, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to container end walls provided with a lifting tap for rupturing a score line in the end wall to create an opening for emptying of the contents of the container. Such container ends are widely used, especially for cans which contain carbonated beverages.

In large numbers of beverage cans at present in use the lifting tab is used to pull off a tear strip. The tear strip and the attached tab may be carelessly discarded, creating unsightly litter which is a hazard to bare feet. Moreover cans ends of this kind are often made of aluminium alloys which can be recycled. Hence efforts have been made to design a container end in which the tap and the tearstrip remain attached to the container and after opening. Many designs have been produced but none has yet achieved commercial acceptance because of the difficulties of ensuring easy and convenient operation without substantially increasing the cost of manufacture.

As one example amonst many reference is made to U.S. Patent Specification No. 3,843,011 in the name of W. M. Perry which described a variety of designs having a tear panel which is depressed into the interior of the container but remains attached to the end wall. In one of these designs the tear panel is bounded by a rupturable score line whose spaced ends define a hinge region by which the panel is integrally attached to the container end and rupturing of the score line is initiated by means of a tab rivetted to the container end outside the area of the tear panel but having an end overlying the margin of the panel. However the panel must then be fully depressed by the pressure of the user's finger and this is not only less convenient than the conventional tear strip, which is removable in a single operation, but also involves a risk of damage to the finger on the severed edges of the opening left by the ear panel. An improved end wall intended to overcome these difficulties is described in U.S. Patent Specification 3,843,011. The object of the present invention is to provide a further improvement in an end wall which meets the requirements for a non-detachable tear panel and tab which are easy to operate and not substantially more expensive to manufacture than the conventional designs.

According to the present invention, there is provided a container end wall having a tear panel defined by a rupturable score line and a liftable tab for opening the container by pressing on the panel to rupture the score line, wherein the score line has two ends spaced apart by a bend region which integrally connects the panel to the end wall following rupture of the score line, the tab is permanently attached to the end wall outside the area of the panel and has a panel-engaging tip located on a forward portion of the tab which overlies a minor part of the panel, the attachment of the tab is nearer to the bend region than it is to the tip of the tab, and the bend region is located to one side of a straight line joining the attachment to the tip, the arrangement being such that upon lifting the rear portion of the tab, the tab initiates severing of the portion of the score line nearest the attachment of the tab and continues the severing action along substantially the remainder of the length of the score line, thereby forcing open the panel.

The tear panel and the tab are preferably symmetrical about the said straight line when extended and in a convenient construction the attachment region of the tab to the end wall is a central region of a circular container end and the said line extends radially from the said central

attachment region. The attachment of the tab is preferably effected by a rivet formed in the end wall. The tab preferably comprises a lug which is attached to the end wall and is integrally connected with the body of the tab forward of the region of attachment whereby the tab pivots by bending in the region where the lug is connected to the tab body.

The invention may also include a composite or laminated tab structure in which one component of the tab is selected for resistance to bending in order to form a relatively rigid lever arm while another component is chosen for resistance to breaking to ensure that the tab remains attached to the can even when it has been lifted and bent to force the tear panel open and then bent back flat against the container end wall to leave the opening clear for drinking from.

The invention will be described in more detail with the air of examples illustrated in the accompanying drawings, in which:—

Fig. 1 is a perspective view of an exemplary container of this invention with the central and a bottom portion thereof broken away and illustrating an easy-open wall of this invention provided as a top wall of such container;

Fig. 2 is a view looking perpendicularly toward the top wall of the container of Fig. 1;

Fig. 3 is a fragmentary cross-sectional view taken essentially on the line 3—3 of Fig. 2;

Fig. 3A is a fragmentary cross-sectional view taken essentially on the line 3A—3A of Fig. 2 particularly illustrating the laminated two-piece construction of the tab which is made of a metallic inner part and a metallic outer part;

Fig. 3B is a view similar to Fig. 3A showing a modification of the tab of Fig. 3A which has an inner part made of plastic;

Fig. 4 is a fragmentary plan view of the central portion of the top wall of the container of Fig. 1 drawn to an enlarged scale and minus the push tab;

Fig. 4A is a fragmentary cross-sectional view taken essentially on the line 4A—4A of Fig. 4;

Fig. 5 is a top plan view illustrating the tab comprising the top wall of the container of Fig. 1 partially lifted to thereby commence severing of the panel along an undulating portion of a score line defining such panel;

Fig. 6 is a fragmentary cross-sectional view taken essentially on the line 6—6 of Fig. 5;

Fig. 7 is a top plan view similar to Fig. 5 illustrating the tab raised an additional angular increment from the plane of the container top wall;

Fig. 8 is a fragmentary cross-sectional view taken essentially on the line 8—8 of Fig. 7;

Fig. 9 is a fragmentary view taken essentially on the line 9—9 of Fig. 7;

Fig. 10 is a view similar to Fig. 7 illustrating the tab raised to a vertical position whereupon the severable panel is severed and remains attached only at a corner thereof;

Fig. 11 is a fragmentary cross-sectional view taken essentially on the line 11—11 of Fig. 10;

Fig. 12 is a view similar to Fig. 2, illustrating the tab returned to its original position flatly against the top wall;

Fig. 12A is a fragmentary cross-sectional view taken essentially on the line 12A—12A of Fig. 12;

Fig. 13 is a fragmentary cross-sectional view taken essentially on the line 13—13 of Fig. 12;

Fig. 14 is a view similar to Fig. 2 illustrating another exemplary embodiment of an easy-open top wall of this invention which may be used interchangeably with the top wall illustrated on any container disclosed in this application;

Fig. 15 is a view similar to Fig. 2 illustrating another exemplary embodiment of an easy-open top wall which may be used interchangeably with the top wall illustrated on any container disclosed in this application;

Fig. 16 is a view similar to Fig. 4 particularly illustrating the detailed construction of the severable panel of the easy-open wall of Fig. 15;

Fig. 17 is a fragmentary cross-sectional view taken essentially on the line 17—17 of Fig. 16;

Fig. 18 is a view similar to Fig. 11 and taken along line 18—18 of Fig. 15;

Fig. 19 is a view similar to Fig. 16 particularly illustrating a modification of the easy-open wall of Figs. 15 and 16;

Fig. 20 is a top plan view of another embodiment of an easy-open end wall of this invention;

Figs. 20A and 20B are enlarged and fragmentary plan views of the two ends of the score line shown in Fig. 20 and in generally the same orientation as for that figure;

Fig. 21 is a sectional view taken along line 21—21 of Fig. 20;

Fig. 22 is an enlarged and fragmentary vertical sectional view taken along line 22—22 of Fig. 20;

Fig. 23 is an enlarged top plan view of an exemplary embodiment of tab construction of this invention;

Fig. 24 is a vertical sectional view taken along line 24—24 of Fig. 23; and

Fig. 25 is a bottom plan view of the tab of Fig. 23.

Description of Illustrated Embodiments

Reference is now made to Fig. 1—13 of the drawings, which illustrate one exemplary embodiment of a container, designated generally by the reference numeral 20 and which utilizes an easy-open wall in the form of a top wall 21K which is made in accordance with the teachings of this invention. The remainder of container 20 may be of any suitable conventional construction and includes a bottom wall 22 adjoined by a substantially right circular cylindrical side wall 23, and the bottom wall 22 and side wall 23 may be provided as a single piece construction or may be made of a plurality of pieces in accordance with known manufacturing techniques.

As best seen in Fig. 4, the wall 21K has formed therein a continuous score line designated generally by the reference numberal 30K and defining the major part of the peripheral outline of a tear panel 35K which is partially severable from the wall to define an opening O therein as seen in Fig. 13, for example. The wall 21K has a tab 36K which is attached thereto in a non-detachable manner outwardly of the panel 35K and the tab has a forward portion 37K which overlies only a minor part of the panel 35K, as shown, and has a rear portion 38K which is adapted to be easily grasped and lifted to urge the forward portion 37K against the panel 35K and move such panel 35K transverse to the wall 21K with a wall portion 34K or portion of the wall 21K holding the panel securely thereto and defining a bend area for the panel.

The score line 30K extends in a continuous curvilinear, i.e. non-rectilinear, path and terminates in what will be referred to as spaced ends 33K. The score line 30K has an undulating portion which is designated generally by the reference numeral 176K adjacent, in this example adjoining, one of the spaced ends 33K with the spaced ends having the previously mentioned wall portion 34K of the wall therebetween. The undulating portion 176K has a valley portion 177K and the undulating portion 176K cooperates with the remainder of the score line 30K to define the panel 35K.

The wall 21K has means for attaching the tab 36K substantially flatly against the wall and such attaching means of this example is in the form of a rivet 43K, preferably defined as an integral part of the wall 21K. As seen in Fig. 3, the rear portion 38K of the tab 36K has an upwardly inclined terminal portion 180K to facilitate grasping or lifting thereof whereby upon lifting the rear portion 38K of the tab 36K, the forward portion 37K pivots about the rivet 43K so as to engage the panel and initially sever the panel 35K from approximately one of the spaced ends 33K and along the undulating portion 176K; and, this initial severing is achieved upon lifting the tab essentially to the position illustrated at 181K in Fig. 6.

This initial severing may be considered as extending along a severed length which is confined within an approximate arc as illustrated at 182K in Fig. 5. Continued lifting of the tab 36K to the position illustrated at 183K in Fig. 8 results in severing along a length which is confined within a comparatively larger approximate arc as indicated at 184K in Fig. 7. Continued lifting of the tab through a comparatively small angular increment so that it is in a substantially vertical position as shown in Fig. 11 results in substantially instantaneous severing of the remainder of the scored portion of the panel in what might be considered a snap action whereupon the panel 35K is arranged transverse and indeed roughly perpendicular the plane of the wall 21K. However, it is to be understoood that while the above description has proceeded as if the severing of panel 35K is achieved in incremental steps, or the like, it is to be understood that such severing is usually achieved in one smooth motion producing a "snap-opening" of the wall 21K.

The tab 36K is then returned from its substantially vertical position to a horizontal or substantially horizontal position as indicated in Figs. 12 and 13 whereupon the severed panel 35K remains attached to the wall 21K at a comparatively remote position near the center of the wall 21K such that there may be unobstructed pouring of the contents of the container 20. Further, any suitable fastening means may be provided to fasten the tab 36K flatly against the top wall 21K and such fastening means may be of any suitable type.

The wall 21K has the continuous score line 30K which terminates in spaced ends 33K, as best seen in Fig. 4; and, the spaced ends 33K have the wall portion 34K therebetween as noted. The wall 21K further comprises an anti-fracture score line 186K which is arranged within the confines of the score line 30K and the anti-fracture score line 186K terminates in spaced ends 187K which are arranged closely adjacent the spaced ends 33K of the score line 30K. In particular, it will be seen that one of the ends 187K is arranged closely adjacent one of the ends of the score line 30K to define a first set 190K of ends and the other of the ends 187K of the anti-fracture score line is arranged closely adjacent the other of the ends 33K of the

score line 30K to define a second set 191K of ends.

The wall 21K also has what will be referred to as a first closing score line 192K extending between the first set 190K of ends and a second closing score line 193K extending between the second set 191K of ends. The closing score lines 192K and 193K cooperate with the score line 30K and the anti-fracture score line 186K to assure precision severing of the panel 35K while holding the panel at the wall portion 34K along transition portions which will be referred to as rounded transition portions and each designated by the reference numeral 194K in Fig. 12A. The rounded transition portions 194K assure that the panel 35K is held substantially free at those points of undesirable tears of the type which might be produced if closing score lines 192K and 192K were not present.

It will also be appreciated that the closing score lines 192K and 193K have suitable depths so that the residual metal remaining therebeneath along their lengths is precisely controlled. In this example, the score lines 192K and 193K gradually decrease in depth from the maximum depth of the score line as indicated at 195K, in the greatly enlarged view of Fig. 4A, to the reduced depth of the anti-fracture score line at 196K. However, the depths of the closing score lines 192K and 193K may be the same throughout their lengths or may be any desired depth for each.

The anti-fracture score line 186K corresponds in configuration to the configuration of the score line 30K as mentioned previously and the anti-fracture score line 186K is equally spaced from the score line 30K about the entire periphery of such score line 30K by a particular distance 197K. The closing score line 192K of this example is approximately semicircular and has a diameter approximately equal to the particular distance 197K. Similarly, the closing score line 193K extends in an approximately circular path having a diameter greater than the particular distance 197K so that the closing score line 193K defines what may be considered a bulbous end between the second set of ends illustrated at 191K.

The wall 21K has a main portion which, as will be readily apparent from the drawings, preferably is formed so as to be substantially in one plane, prior to being seamed to the side wall of a container. It will also be seen particularly from Figs. 3 and 4, that the panel 35K has embossing means which in this example is in the form of a single embossment 198K therein serving as a strengthening and force transmitting structure and assuring easier severing of the panel 35K. The embossing means 198K may have any suitable peripheral outline and instead of being a single embossment may be in the form of a plurality of embossments. Further, the embossing means of this example has a peripheral outline which corresponds approximately with the outline of the score line 30K, and hence the anti-fracture score line 186K, and the embossing means 198K is in the form of a depressed portion as illustrated at 200K which extends beneath the plane of the main portion of the wall 21K. The embossing means may also be in the form of a single raised portion corresponding to the outline of depressed embossment 198K, as will be evident.

The tab 36K may be made of either a single piece or a plurality of pieces of material, either metallic or non-metallic, and in the case of metallic material may be made of either ferrous or non-ferrous metal. However, such tab 36K is preferably in the form of a laminated or layered construction made of a plurality of components which are suitably held together. In particular, and as illustrated in Figs. 2, 3, 3A and 3B, for example, the laminated tab 36K may comprise an outer structural member 201K and an inner member or insert 202K fixed within the outer structural member. Components 201K and 202K may be made of metallic materials, such as aluminous materials and as illustrated in Fig. 3A; and, with the outer member 201K being selected because of its structural strength and the inner metallic member or insert 202K being selected because of its capability of being flexed or bent sharply several times, if desired, without breaking into two tab parts.

It will also be appreciated that the tab 36K may have its outer structural member 201K made of a metallic material and the insert made of a suitable plastic material also designated 202K and as illustrated by suitable crosshatching in Fig. 3B. The plastic material is also selected so that the tab may be flexed or bent sharply several times without breaking of the tab into two tab parts.

The score line 30K and panel 35K defined thereby are shown as being symmetrical about a common longitudinal axis; and, the tab 36K has a longitudinal axis which is arranged parallel to and in vertically aligned relation above the longitudinal axis of the score line and panel. Indeed, as will be apparent from Fig. 2, the common longitudinal axis of the score line 30K and panel 35K is a diametral line which coincides with the section line 3—3 as indicated at 203K.

The laminated tab 36K may be attached to the wall 21K in any suitable manner; however, as seen in Figs. 1 and 3, such tab

has a roughly U-shaped cut or slit which will be designated generally by the reference numeral 61K to define an attachment area lug 62K therewithin. The lug 62K has an opening 63K therethrough for receiving a rivet 43K used to fasten the tab 36K to the wall 21K in conventional fashion. The cut 61K is shown as having a relatively substantial width as indicated at 205K and is provided with a pair of substantially semicircular ends 206K defining an imaginary bend line for the attachment area 62K and hence the tab 36K.

The rivet 43K is defined as an integral part of the wall 21K in accordance with techniques well known in the art; and, the rivet 43K is defined and arranged so that it remains substantially in the same position upon returning tab 36K to its original position after severing the panel 35K. For example, the position of the rivet may be readily observed at 207K in Fig. 3 prior to severing of the panel 35K. After severing the panel essentially in the manner illustrated in Figs. 5—11, and returning the tab flatly against the top wall 21K in the manner illustrated in Fig. 13, the unique laminated construction of the tab not only assures that the tab will not break in two tab parts but also assures that the rivet 43K remains substantially intact and in the position shown at 207K in Fig. 3 as will be seen at 208K in Fig. 13.

In the example illustrated in Figs. 1—13 the score line 30K and anti-fracture score line 186K are approximately heart-shaped and it will be seen that the spaced ends 33K adjacent the wall portion 34K are arranged adjacent the top corner of what would be considered a top corner of the heart-shaped score line 30K. However, it will be appreciated that the concept of this invention may be provided with easy-open walls having score lines which have other configurations, such as those referred to hereinbelow.

For example, a modification of the easy-open wall of this invention is illustrated in Fig. 14 and designated by reference numeral 21L wherein a roughly heart-shaped score line 30L is provided without an anti-fracture score line, although it will be appreciated that a score line similar to score line 186K may be provided together with the associated closing score lines as described above. The score line 30L of wall 21L has an undulating portion 176L and side portions 209L which are roughly parallel. The bottom portions of the side portions 209L are joined by a roughly semicircular portion 210L which extends through an arc of approximately 180°.

The panel 35L of wall 21L also has embossing means 198L therein and such embossing means is recessed inwardly beneath the main plane of the wall 21L. In addition, the wall 21L has an inwardly extending strengthening bead structure 211L of roughly U-shaped configuration and such wall uses a tab 36L which is substantially identical to the tap 36K of wall 21K.

Still another modification of the wall 21K is illustrated in Figs. 15—18 and designated by the reference numeral 21M with similar reference numerals being used to indicate similar parts, as previously described; and, with new reference numerals, also followed by the reference letter M being used to designate substantially different parts or portions.

In particular, it will be seen that the part of the score line 30M which is arranged remote from the undulating portion 176M of such score line 30M extends in a circular path. Similarly, that part of the anti-fracture score line 186M which is arranged remote from its undulating portion 188M also extends in a corresponding circular path. Accordingly, it will be seen that the panel 35M may be considered a substantially circular panel which is easily severed in a similar manner as described in connection with the heart-shaped panel 35K of wall 21K. The panel 35M is easily severed by lifting the tab 36M substantially vertically in a similar manner as shown in Fig. 11 for the panel 35K to define an opening in the wall 21M whereupon the tab 36M is returned flatly against the wall 21M whereby the contents of a container, such as container 20 of Fig. 1, for example, on which wall 21M may be installed may be poured therefrom in an unobstructed manner.

In a similar manner as in the wall 21K, the wall 21M has its score line 30M terminating in spaced ends 33M and the anti-fracture score line 186M terminates in spaced ends 187M similar to the spaced ends 187K of anti-fracture score line 186K. The ends 33M are spaced apart a small arcuate length less than 30° and generally of the order of 10° as shown at 212M in Fig. 16. In addition, closing score lines 192M and 193M are provided in a similar manner and as previously described in connection with closing score lines 192K and 193K in the wall 21K. It will also be seen that the score line 30M has an undulating portion 176M provided with a valley portion 177M within which at least a portion of the rivet 43M is nested and in a similar manner as the rivet 43K is nested within its associated valley portion 177K. The anti-fracture score line 186M also has an undulating portion 188M.

Wall 21M has further strengthening and force transmitting means therein which

cooperate with embossing means 198M to assure efficient transmittal of severing forces once the tab 36M is lifted. It will be noted that the embossing means 198M is outwardly convex or is raised outwardly from the top wall 21M. In particular, such further means in wall 21M which assure more efficient transmittal of severing forces includes an inwardly convex bead 213M which surrounds raised embossment 198M of panel 35M and conforms roughly in configuration to panel 35M. The inwardly convex bead 213M is substantially circular throughout its peripheral outline except for a portion which is arranged beneath the tab 36M.

It will also be seen that the wall 21M has still another reinforcing means or reinforcement provided therein to give structural rigidity and integrity thereto; and, such reinforcement is in the form of a U-shaped outwardly convex ridge or bead 214M which extends around the entire panel 35M, tab 36M, and rivet 43M. In addition, wall 21M has reinforcing means in the form of an inwardly convex substantially rectilinear indentation 215M which is arranged outwardly of the rivet 43M and substantially within the confines of an imaginary line extending between the terminal ends of the substantially U-shaped outwardly convex strengthening ridge 214M.

Still another modification of the wall 21K is illustrated in Fig. 19 of the drawings in a showing which is similar to Fig. 16 to highlight the details thereof. The wall of Fig. 19 is designated by the reference numeral 21N and with similar reference numerals being used to indicate parts which are similar to corresponding parts of the wall 21M. The wall 21N may also be used interchangeably with the wall 21M and all other walls disclosed herein which utilize the reference number 21 as the first part thereof.

The wall 21N of Fig. 19 has a score line 30N with spaced ends 33N, an anti-fracture score line 186N with spaced ends 187N, and closing score lines 192N and 193N. In addition, the wall 21N has an undulating portion 176N in its score line 30N and an undulating portion 188N in its anti-fracture score line 186N. Similarly, an integral rivet 43N is provided to fasten a tab 36N (not shown), which is substantially identical to the tab 36M, to the wall 21N.

In addition, the wall 21N has an outwardly convex portion 198N similar to portion 198M, a strengthening or structural bead similar to bead 213M, a strengthening bead similar to bead 214M, and an inwardly convex rectilinear embossment similar to embossment 215M. The main differences between the wall 21N and the wall 21M are in the configurations of those parts of the score line 30N and anti-fracture score line 186N which are arranged remote from their respective undulating portions 176N and 188N. In particular, each of these remote portions extends in an elliptical path rather than a circular path. Thus, the elliptical path of score line 30N remote from undulating portion 176N has the usual oppositely arranged curved side portions 216N adjoined by curved end portion 217N; and, the elliptical path of anti-fracture score line 186N remote from its undulating portion 188N has portions corresponding to portions 216N and 217N while being arranged within the confines of these last two reference numerals as well as being equally spaced therefrom. It should also be noted that raised embossment 198N is substantially elliptical in outline and corresponds to the outlines of the score line 30N and the anti-fracture score line 186N.

It should be mentioned in connection with the severing action of panels 35K, 35L, 35M and 35N of walls 21K, 21L, 21M and 21N, respectively, that in each instance the rear portion of the associated tab is adapted to be easily grasped and lifted to urge the tab forward portion against its associated panel and simultaneously lift the associated attaching means and adjoining portions of the wall and thereby initially sever the panel along its undulating portion and thereafter sever the panel along at least a portion of the remainder of the score line adjoining the undulating portion by depressing the panel relative to its attaching means and adjoining portions of the wall.

Figures 20—25 of the drawings illustrate a currently preferred embodiment of an easy-open wall and non-detachable tab of this invention. The easy-open wall illustrated in Figures 20—21 is in the form of an end or top wall and is very similar to the top walls 21K, 21L, 21M and 21N shown in Figures 1—19. Likewise, the non-detachable tab illustrated in Figures 20—25 is similar to the tab constructions 36K, 36L and 36M shown in Figures 1—18. Therefore, the easy-open wall and non-detachable tab of Figures 20—25 will be designated generally by the reference numerals 21′ and 36′, respectively, so as to avoid confusion with the other embodiments previously described. Parts of the wall 21′ and tab 36′ which are similar to corresponding parts of the walls 21K, 21L, 21M and 21N, and tabs 36K, 36L and 36M will be designated by the same reference numerals as in the case of Figures 1—19 embodiments, but followed by the prime designation (′) and, in general, described only as deemed appropriate.

The end wall 21′ is suitably installed on a container (not shown in Figures 20—21) by

having the flange 24' appropriate secured to the upper end of the container side-wall, as indicated, for example, in Figure 3. The container may be made by any suitable process, and it may be made of any suitable material, such as aluminous alloys, as is well known. Likewise, the easy-open wall 21' may be made by any suitable process, not forming part of the present invention, and it may be made of aluminous or ferrous alloys.

As best seen in Figure 20, the wall 21' is provided with a continuous score line somewhat similar in outline to the score lines 30M and 30N shown in Figures 16 and 19, respectively. It will be seen, however, that score line 30' is not quite circular in outline as is score line 30M but it is somewhat more circular in outline at its outer end than the score line 30N. In this embodiment, the outer score line and the anti-fracture score line 186' are each of a uniform score residual thickness between the ends 33'. For an exemplary construction, and with reference to Figure 22, the score residual thickness 195' of the outer score line 31' is about 0.005 inches and the score residual thickness 196' of the anti-fracture score line 186' is about 0.008 inches. The distance 200' between the centers of the score lines, in this example, is approximately 0.050 inches, with the minimum width at the bottom of the outer score line 31' being approximately 0.002 inches and the minimum width at the bottom of the anti-fracture score line 186' being approximately 0.002 inches.

In the closing score lines 192' and 193' at the ends 33' of the score line, there will be suitable transitions to account for the difference in size, shape and score residual thickness between the outer score line 31' and the inner, anti-fracture score line 186', as will be understood. Exemplary closing score lines are indicated in Figures 20A and 20B.

In Figures 20A, closing score line 193' will be seen to be bulbous and generally circular in outline, and in vertical cross-section it is of the same size, shape and score residual thickness as outer score line 31' (moving in a counterclockwise direction from outer score line 31') until it reaches the approximate position T_1 at which time it will gradually change until it reaches the end of the transition section as indicated approximately at about T_2 at which point it will be the same in vertical cross-section as the inner score line 186'. The diameter of the bulbuous closing score line 193' in the example under consideration, is about 0.094 inches.

In Figure 20B, closing score line 192' will be seen to be generally semicircular in outline and in vertical cross-section it is of the same size, shape and score residual thickness as outer score line 31' (moving in a clockwise direction from outer score line 31') until it reaches the approximate position T_3 at which time it will gradually change until it reaches the end of the transition section, as indicated approximately at about T_4, at which point it will be the same in vertical cross-section as the inner score line 186'. The diameter of the closing score line 192' in the example under consideration, is about 0.050 inches.

The closing score lines 192' and 193' may be of any suitable score residual thickness for the purposes intended, as will be understood.

An embossment 213' is provided in the end wall 21' within the area bounded by the score line 30' and similar in outline thereto, but terminating in spaced ends, as shown in Figures 20 and 21. Embossment 213' may either be in the form of a raised surface in the end wall 21', as shown, or it may be formed as a depression therein. In any event, it serves the same purpose as the corresponding embossment 213M shown in Figures 16 and 17 and described hereinabove.

Wall 21' is also shown as including two ridges 214' flanking score line 30', as best seen in Figure 20. These ridges 214' are provided for the same purpose as the reinforcing ridge 214M shown in Figures 16 and 17 and described above. Furthermore, wall 21' is formed with a curved, somewhat semicircular indentation 215' therein, serving essentially the same purpose as the indentation 215M shown in Figure 16 and described above.

The embossments 213', 214', and 215' will function to take up loose metal resulting from the formation of the score lines and the rivet, as will be understood.

While the beads 214' and indentation 215', in the size and shape thereof shown in Figures 20 and 21, are believed to be advantageous, it will be understood that variations may be made therein without departing from the principles of the invention. Likewise, as should be evident, they may be formed either as indentations or as raised portions of the end wall, as desired, and the same is true as to the corresponding or similar structures shown in the other embodiments of the invention disclosed herein. It will also be understood that, if desired, the score line 30', as well as the other score line embodiments disclosed herein, may be formed on the inside surface of the end wall 21'.

The end wall 21' is shown as being provided with a rivet 43' for attachment to the tab 36', in a suitable manner, as indicated above for the embodiments shown in Figures 1—19. Tab 36' is made of

any suitable stiff and strong material, such as an aluminous or ferrous alloy, for the purposes intended. In the embodiment thereof shown in Figures 20—25, it is preferably made of an aluminous alloy.

The tab 36' is shown as being of generally elongated outline having the forward rupturing portion 37' and a rear lifting portion 38' with somewhat concave side portions 360, 361 extending therebetween. The forward rupturing portion 37' is shown as being circularly arcuate and overlies only a minor portion of the tear panel 35' defined by the score line 30', and with the forwardmost tip of portion 37' being disposed over an unscored portion of the tear panel. The rear lifting portion 38' is shown as including an undulating indentation 362 which may be utilized to facilitate insertion of a finger thereunder for lifting purposes.

Tab 36' is shown as including a generally flat, depressed, main portion 201' having an upstanding peripheral ridge or flange 363 therearound and a generally U-shaped cut 61' formed therein with generally semicircular ends 206' defining therebetween an imaginary hinge or bend line for the tab. An attachment area or lug 62' is provided by the cut 61' in the manner previously described.

The tab construction 36' is shown as including an insert 202', thus constituting a composite tab. As best seen in Figures 21 and 23—25, the insert includes a main body portion 364 substantially coextensive with the attachment area 62' defined by the cut 61', as well as a forward flaring portion 365 extending over a substantial part of the forward rupturing portion 37'. The insert main portion 364 and tab main portion 201' are respectively provided with aligned holes 366, 366' therein, to receive the rivet 43', as best seen in Figures 21 and 23—25.

The tab flange 363 includes a portion curled or rolled thereunder to define a reinforcing bead or rib. As best seen in Figures 24 and 25, this curled portion also extends under and in engagement with the front edge of the flared portion 365 of insert 202'. In that regard, it will be noted that such edge follows the curvature of the tab in the region of the forward rupturing portion 37', as best seen in Figures 23—25.

The curled portion of the tab flange 363 in the region of the tab forward portion is flattened or crimped at 367 and 368 to grip and hold the insert 202' to the tab, thus making the composite tab a laminated construction. Crimped portions 367, 368 also provide a depending lobe 369 at the front tip of the tab, as well as lobe-like structures 370, 371 at the opposite ends of the portions 367, 368, as best seen in Figures 24 and 25. The purpose of these lobes will be evident as the description proceeds.

The insert 202' may be made of any suitable pliable material for retention of the tab to the end wall. In this embodiment, both the tab 36' and the insert 202' are made of an alloy of aluminum with the tab being made out of a stiff and strong aluminum alloy, such as, for example, 5182-H19 with the insert 202' being made of, for example, a dead soft aluminum alloy, 80790. The tab 36' and insert 202' preferably are uncoated (i.e., bare metal) and may be of any desired thickness, such as about 0.010 inches for insert 202' and about 0.0186 inches for tab 36'.

The flared sides of forward portion 365 of the insert 202' are disposed so as not to extend along the imaginary hinge line extending between the cut ends 206' so as not to interfere with the pivoting of the tab for opening the container.

The composite tab construction 36', 202' may be made by any suitable method, which is not part of the present invention. It will be understood, though, that the tabs 36' and inserts 202' may be formed out of suitable sheet or strip metal stock by appropriate dies (not shown) and suitably held together prior to forming the peripheral reinforcing rib or bead on the tab so that the final tab construction may be as shown in Figures 23—25.

As indicated heretofore, the insert 202' may alternatively be constructed of a suitable plastic material, for example, polypropylene or high density polyethylene, to achieve the same purpose of increasing the resistance of the composite tab construction to fatigue failure.

The insert 202', whether made of metal or plastic, will be suitably held to the tab 36' to constitute a composite of laminated tab construction, as indicated above for the metal insert 202'.

It will be evident that the composite tab construction shown in Figures 23—25 may be utilized in place of any of the tab constructions shown in the embodiments of Figures 1—19.

As an alternative tab construction, the tab 36' may be made with the main portion 201' thereof omitted, so as to comprise only the peripheral flange 363 and attachment area 62', if desired. In that case, the outline of the peripheral flange 363 and its size and shape may be varied for strength or other purposes, as will be appreciated.

In the operation of the embodiments shown in Figures 20—25, a finger may be inserted under the tab rear lifting portion 38' to start the opening process. During the initial lifting phase the depending lobe 369 at the tip of the tab forward rupturing

portion 37' will be brought into pressure contact with an unscored area of the tear panel 35', as indicated in Figures 20—21, and this pressure contact will be facilitated by reason of the pressure inside the container when same contains a carbonated beverage such as a soft drink or beer. This initial lifting of the tab rear portion has been observed to involve a generally second-class lever action wherein the fulcrum will be substantially in the region of the area of contact between the tab depending lobe 369 and the tear panel 35' so as to cause a lifting of the rivet 43' and adjacent portions of the end wall 21' while the lobe 369 is pressing down on the tear panel 35'. As the tab rear portion is lifted farther, more pressure will be exerted by the depending lobe 369 against the tear panel, there will be a greater tendency to lift the rivet and adjacent portions of the end wall 21' and there will be some bending of the tab along the imaginary hinge line between the cut ends 206'. This generally second-class lever action will continue until sufficient forces are generated to cause an initial severing of the undulating portion 176' of the score line in the vicinity of the rivet 43'. This initial severing may be considered as extending along a severed length approximately defined within an arc such as the arc 182K in Figure 5. Further, the initial severing, in the exemplary construction under consideration, has been observed to extend into the closing score line 193' to about the point T_1, as shown in Figure 20A.

It is believed that the aforesaid initial severing is caused essentially by tensile action and is achieved upon lifting the tab rear portion 38' approximately to the position illustrated for tab 38K in Figure 6. It will be appreciated that the depending lobe 369 will help to reduce the force required to achieve initial severing, for example, by localizing the area of pressure contact between the tab front portion and the tear panel.

Continued lifting of the tab 36', for example, to the position illustrated for tab 36K in Figure 8, results in propagation of the initial severing along a larger severed length, for example, as indicated approximately by arc 184' in Figure 20. This severing is believed to be caused essentially by shearing action.

Further lifting of the tab through a comparatively small angular increment so that it is in a substantially vertical position, as indicated for tab 36K in Figure 11, results in substantially instantaneous severing of the remainder of the scored portion of the panel 35' in what might be considered a snap action whereupon the panel 35' is depressed downwardly, transverse to the wall 21', for example to a position approximately corresponding to the position of panel 35K indicated in Figure 9. This latter severing is also believed to be caused essentially by shearing action, and the severing thus will extend between the spaced ends 33' of the score line with some severing extending into the curved transition ends, as previously indicated.

While the description of the opening operation for the embodiments of Figures 20—25 has proceeded as if the severing of the panel 35' were achieved in incremental steps or the like, it is to be understood that such severing is usually achieved in substantially one smooth motion producing a "snapopening" of wall 21'. In that regard, after the initial severing occurs during which the tab has been observed to function generally as a second-class lever with the fulcrum essentially at the depending lobe 369 at the front tip of the tab, as noted above, further lifting of the tab rear portion is effected with the tab functioning generally as a first-class lever with the fulcrum disposed in the region of the rivet 43 and substantially along the imaginary hinge line between the ends 206' of the U-shaped cut 61' of the tab. Furthermore, as the severing of the score line is propagated from the initial severing in the undulating portion 176' and along the adjacent side portion 216', the periphery of the flange 363 and reinforcing bead between the lobes 369 and 371 is pressed into progressive, sliding contact with the panel 35' to cause propagation of the severing of the score line from side portion 216' through the arcuate portion 217' and through the opposite side portion 216', all the way to the other end 33', 192', with the panel 35' bending about the wall portion 34'. When the tab reaches the vertical or substantially vertical position, as indicated in Figure 11 for tab 36K, side lobe 371 on the tab forward portion will be in contact with the wall portion 34' to be sure that the tear panel 35' is opened, and the tear has been observed to extend into closing score line 192' to about point T_3, as shown in Figure 20B.

It has been found that upon opening of the tear panel 35', in the manner described, the initial tear line occurs along the outside corner 380 of the bottom of the score line 31', as shown in Figure 22 and that the tear will continue in that corner until approximately point P_1 is reached, as indicated in Figure 20. Thereafter, and approximately until point P_2 in Figure 20 is reached, the line of severing appears to shift over to the inner corner 381 of the bottom of the score line 31', at which point it is sharply transferred back to the outer

corner 380 for the rest of the severing to the other end 33', 192'.

The apparent changeovers of the line of severing, just referred to, even if resulting in a sharply defined edge, as at point P_2, are so small as to be hardly noticeable.

After the tear panel 35' has been opened, in the manner describd, the tab 36' may be pivoted back about the imaginary hinge line between cut ends 206' to a flat or substantially flat position, as indicated in Figures 20—21 so as to be out of the way for pouring or drinking purposes.

The foregoing description of the opening function of the tab 36' is also essentially applicable for the tabs 36K, 36L, 36M (and 36N, not shown) in the embodiments of Figures 1—19 described hereinabove.

Thus, it will be seen that even though the forward rupturing portions of the tabs overlie only a minor part of the tear panel in all of the embodiments herein, with the front tips of the tabs overlying an unscored region, actuation of the tabs will nevertheless effect a complete severing of the score line. Furthermore, upon returning the tab to a flat or substantially flat position, after opening the tear panel, the opening will not be significantly obstructed by the tab forward portion.

The unique construction of the tab and tear panel, including having the unscored wall portion defining the tear panel bend area arranged to one side of the rivet, it believed to significantly reduce the forces required for opening the tear panel while still providing a satisfactory opening for pouring or drinking.

It will be seen that in each of the embodiments described the bend region between the ends of the score line is located on the same side of the tip of the tab as the region of attachment of the tab to the end wall and to one side of a line joining the said region of attachment to the tip of the tab. While the undulating part of the score line curves closely around the side of the rivet facing the tip of the tab and lies wholly within the area covered by the tab, the other end of the score line lies at or very near the edge of the tab so that the bend region lies wholly within the area embraced by the tab.

The composite construction of the tab disclosed hereinabove will improve retention of that structure on the end wall in the event repeated flexings should result in tearing of the main body portion of the tab from the attachment area, for example, in the region of the imaginary hinge line between ends 206' in Figure 23. In that event, the insert, for example 202' in the Figures 20—25 embodiment, will still be intact and will function to retain the composite tab to the can end.

As indicated above, it has been found that by reason of the design of the closing score line 193', the initial tear of the outer score line 31' will terminate at one end at about the point T_1 as indicated in Figure 20A so that the tear does not propagate into the unscored bend area 34'.

The end walls of this invention preferably are initially formed so as to be essentially flat, as indicated, for example, in Figures 3 and 21. When they are seamed to the side wall of a container having a pressurized beverage therein, the end wall will be distended or domed upwardly by the pressure therein. Thereafter, when the tear panel is severed, the pressure in the container will be vented and the end wall will return to its substantially flat or planar condition. The upward doming of the end walls of the present invention, as just described, has been found to facilitate the severing of the tear panel. Furthermore, after the tear panel has been severed and the container vented, the return of the end wall to a substantially flat position provides for return of the tab to a substantially flat position where it will be disposed substantially below the plane of the chime of the end wall.

It might also be noted that because of the unique construction of the tabs and tear panels of the present invention, venting of the contents of the container will occur during the intitial severing described above, for example, along the undulating section 176' shown in Figure 20. The spray which normally accompanies such venting will then be directed against the undersurface of the tab which thus acts as a shield to protect the user from the spray, even if undesirably high pressures had developed outside the container, as by agitation.

Furthermore, by not having the front end of the forward rupturing portion of the tab of the present invention directly overlie any portion of the score line, protection will be afforded against accidental or premature venting of any pressurized beverage in the container, should high forces or shock loads be applied to the front of the tab during handling, shipping, storage and the like. In that regard, it will be appreciated that the initial severing of the score line occurs in the vicinity of the tab pivotally attaching means by reason of same being lifted upwardly through the action of lifting the rear portion of the tab. It has been found that even with the application of relatively high inwardly or downwardly directed forces on the tear panel in the region thereof under the front end of the tab and without any concurrent lifting of the container end wall in the region of the pivotally attaching means, no severing of the score line occurs.

WHAT WE CLAIM IS:—

1. A container end wall having a tear panel defined by a rupturable score line and a liftable tab for opening the container by pressure on the panel to rupture the score line, wherein the score line has two ends spaced apart by a bend region which integrally connects the panel to the end wall following rupture of the score line, the tab is permanently attached to the end wall outside the area of the panel and has a panel-engaging tip located on a forward portion of the tab which overlies a minor part of the panel, the attachment of the tab is nearer to the bend region than it is to the tip of the tab, and the bend region is located to one side of a straight line joining the attachment to the tip. The arrangement being such that upon lifting the rear portion of the tab, the tab initiates severing of the portion of the score line nearest the attachment of the tab and continues the severing action along substantially the remainder of the length of the score line, thereby forcing open the panel.

2. A container end wall according to Claim 1, wherein the tip is located to press initially on the panel at a point spaced from the score line.

3. A container end wall as claimed in Claim 1 or 2, in which the bend region lies wholly within the area covered by the tab.

4. A container end wall as claimed in Claim 3, in which one end of the score line lies at the edge of the front portion of the tab.

5. A container end wall as claimed in any of Claims 1 to 4, in which the tab and the part of the tear panel not covered by the tab are substantially symmetrical about the said straight line when the line is extended across the tab and the panel.

6. A container end wall as claimed in any of the preceding claims, in which the attachment of the tab to the end wall is at a central region of a circular end wall.

7. A container end wall as claimed in any of the preceding claims, in which a lug of the tab is attached to the end wall by a rivet, the lug being integrally connected with the tab in a region forward of the rivet such that the tab can pivot by bending about the said forward region.

8. A container end wall as claimed in Claim 7, in which the rivet is integrally formed in the end wall.

9. A container end wall as claimed in Claim 7 or 8, in which the lug and the region of connection of the lug with the tab have a composite structure with a first layer of relatively stiff material which forms the rest of the tab and a second layer of relatively soft bendable material which ensures the attachment of the tab to the end wall in the event of fracture of the first layer resulting from bending to and fro.

10. A container end wall as claimed in Claim 9, in which the edge of the first layer of the tab is turned over to embrace the edge of the second layer and to provide a strengthened edge on the forward portion of the tab.

11. A container end wall according to Claim 9 or 10, in which the first and second materials are aluminum alloys differing in composition and/or in conditioning by cold working or heat treatment.

12. A container end wall as claimed in any of Caims 7 to 11, in which the part of the score line adjacent the attachment region curves closely around the side of the rivet facing the tip of the tab.

13. A container end wall as claimed in any of the preceding claims, in which the forward position of the tab has a semi-circular periphery.

14. A container end wall as claimed in any of the preceding claims, in which the tip of the tab has a downward projection for initial engagement with the panel.

15. A container end wall as claimed in any of the preceding claims, in which a second score line of lesser depth extends alongside the rupturable score line over its full length and is joined to the ends of the rupturable score line by a curved connecting score line, the second score line lying within the area of the tear panel enclosed by the rupturable score line.

16. A container end wall as claimed in any of the preceding claims, in which the tip of the tab is closer to the region of attachment of the tab to the end wall than it is to the remotest part of the score line bounding the tear panel.

17. A container end wall as claimed in any of Claims 1 to 14, wherein the score line includes two spaced portions extending from beneath the forward portions of the tab into a generally arcuate portion, and wherein upon lifting of the tab the severing is propagated along one of said spaced portions then through said generally arcuate portion and then along the other of said spaced portions.

18. A container end wall substantially as

described with reference to Figures 1 to 14 or Figures 15 to 19.

19. A container end wall substantially as described with reference to Figures 20 to 25.

REDDIE & GROSE,
Agents for the Applicants,
16, Theobalds Road,
London, WC1X 8PL.

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1540229 COMPLETE SPECIFICATION
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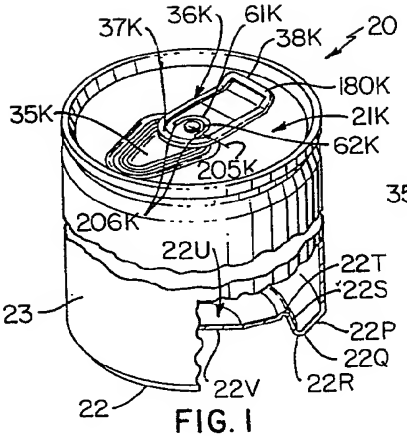

FIG. 1

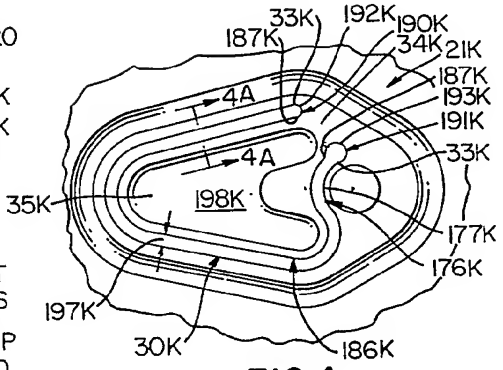

FIG. 4

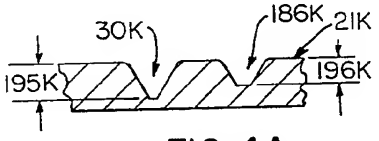

FIG. 4A

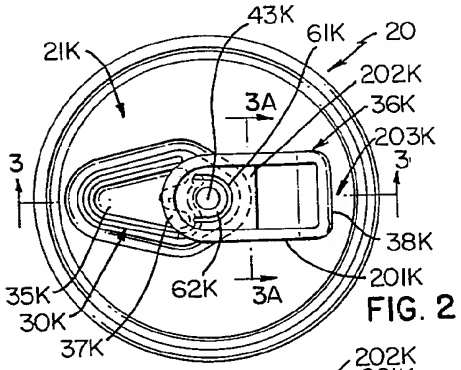

FIG. 2

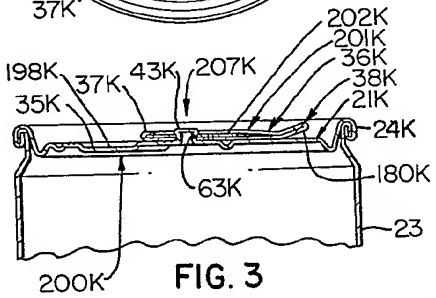

FIG. 3

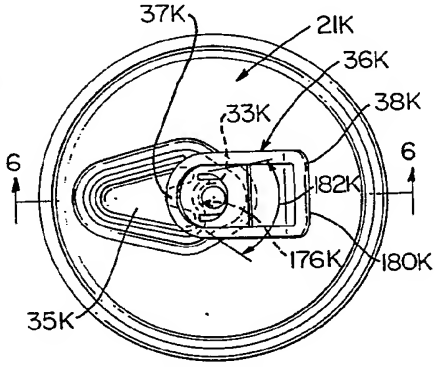

FIG. 5

FIG. 3A

FIG. 3B

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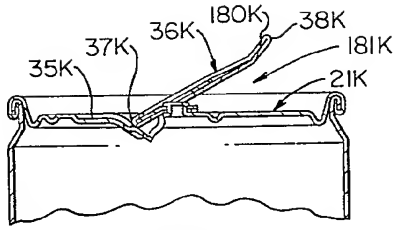

FIG. 6

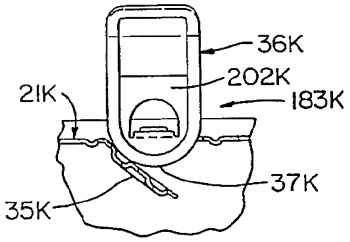

FIG. 9

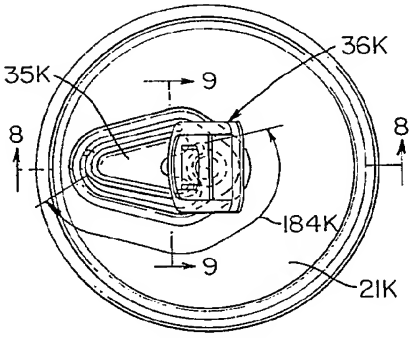

FIG. 7

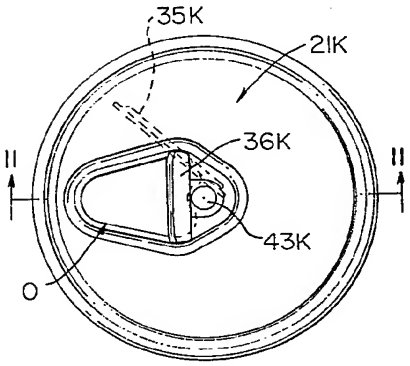

FIG. 10

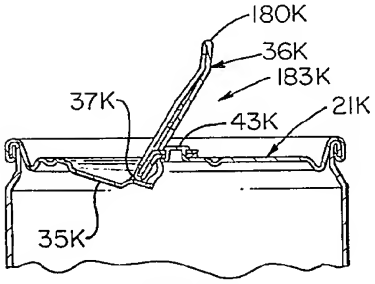

FIG. 8

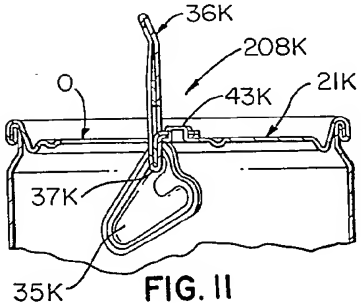

FIG. 11

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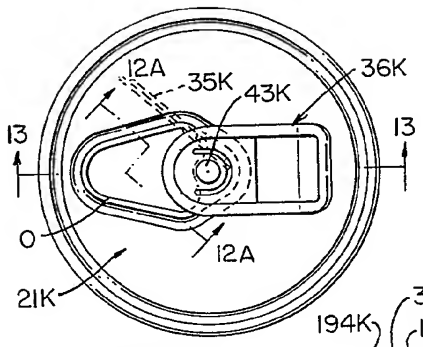


FIG. 12

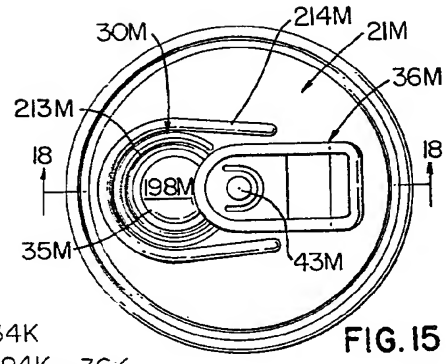


FIG. 15

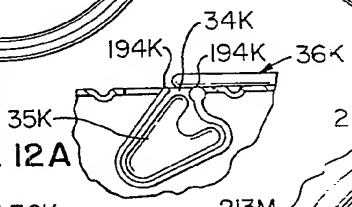


FIG. 12A

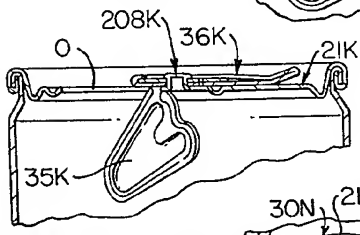


FIG. 13

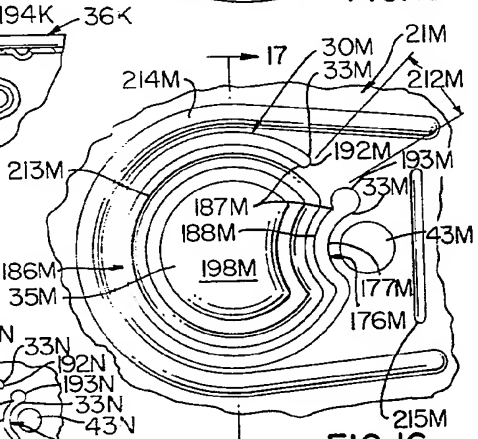


FIG. 16

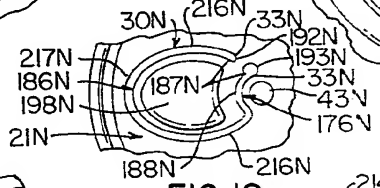


FIG. 19

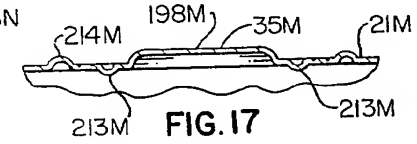


FIG. 17

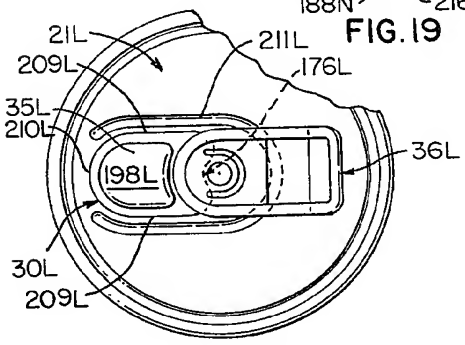


FIG. 14

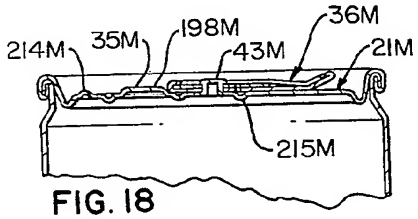


FIG. 18

FIG. 20

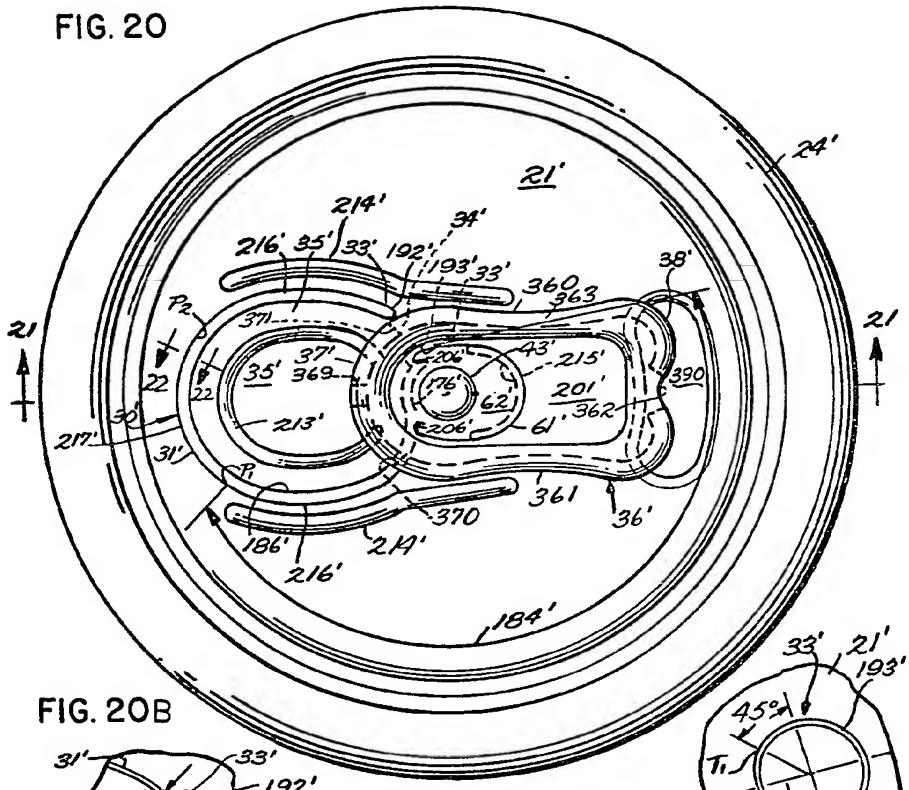


FIG. 20B

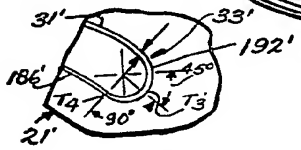


FIG. 20A

FIG. 21

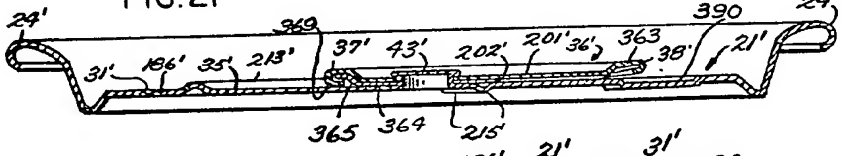


FIG. 22

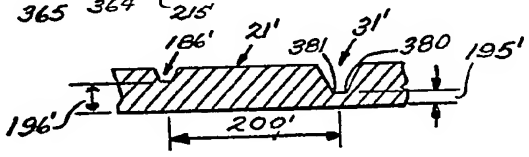
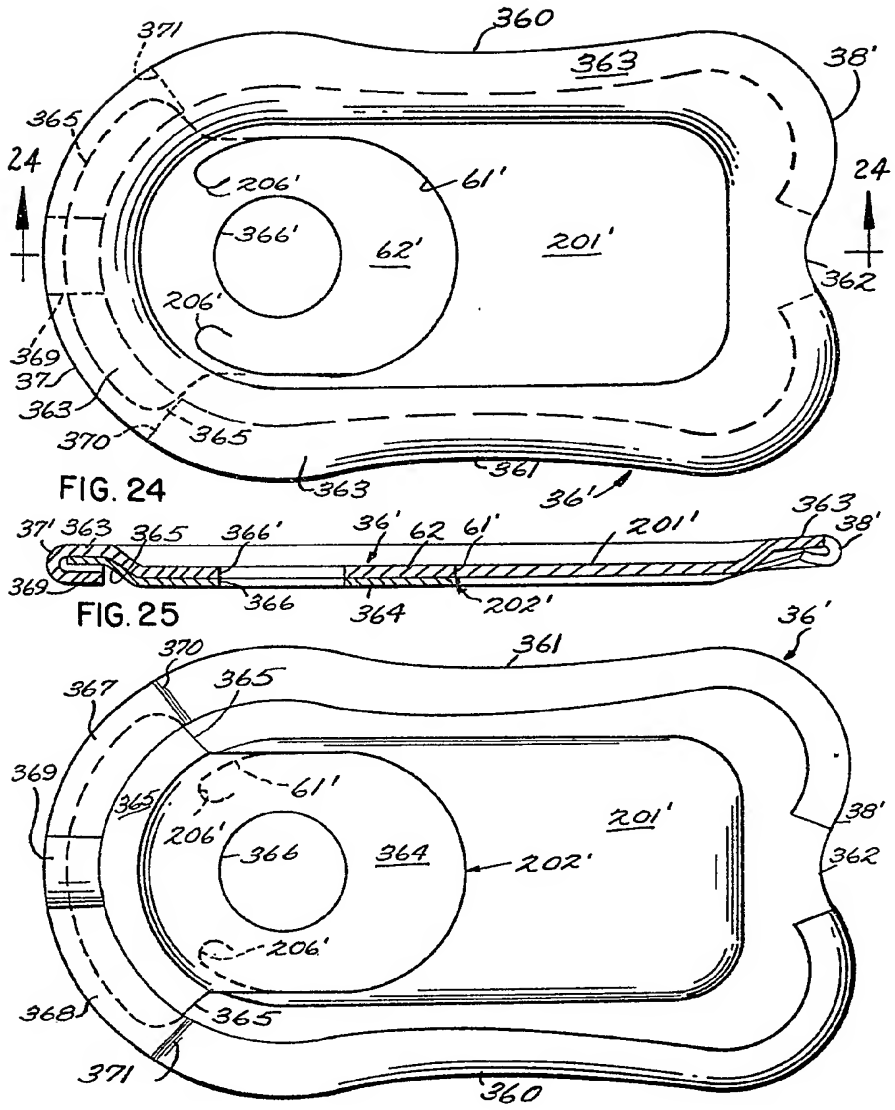


FIG. 23


360
371
363
38'
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201'
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FIG. 24
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FIG. 25
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